ANALYSIS OF TRAFFIC ACCIDENT DATA AND IN-DEPTH INVESTIGATION DATA IN JAPAN

Tetsushi Miyake

Institute for Traffic Accident Research and Data Analysis Japan Paper Number 496

ABSTRACT

In Japan, the number of traffic accidents and slight injuries has increased in recent years, but the number of fatalities has decreased. However, among fatalities in vehicles, the number of older people has increased 1.8 times during the last ten years.

Among serious injuries involving older people in vehicles examined by type of accident, the percentage of crossing collisions is noticeably greater than in other age groups. Older people tend to be more seriously injured with the same impact.

This paper describes the recent status of traffic accidents in Japan based on nationwide traffic accident statistics. In particular, it shows the change of casualties in vehicles. It also identifies human errors leading to accidents involving older drivers and how their chest injuries are caused in low-speed collisions based on the in-depth investigation studies. It suggests both active and passive safety measures for older drivers.

INTRODUCTION

Traffic fatalities in Japan, which fell to 8,466 in 1979 from its peak of 16,765 in 1970, have since turned upward and attracted public concern. Facing the seriousness of the traffic accident problem, the government declared a "state of emergency" in 1989: urgent measures were needed for traffic accidents caused by the rapid motorization of the country.

With this background, TV stations aired special programs reporting how Germany halved the number of fatalities in their country. In the Diet, deputies asked the government in June 1990 to improve and reinforce the system of research and analysis of traffic accidents. Administrative bodies were recommended to develop an advanced system of statistical analysis by improving and reinforcing various statistics on traffic accidents and to organically integrate statistics on traffic accidents, roads and vehicles. The advisors also suggested that comprehensive research and survey of traffic accidents be conducted through scientific approaches in collaboration with experts in engineering, medicine, and psychology.

Consequently, the ITARDA was founded in March 1992 with the collaboration of the government, the Japan Automobile Manufacturers Association (JAMA), the Marine and Fire Insurance Association of Japan and so forth.

The ITARDA provides the results of its analysis of macrostatistics to administrative agencies, car manufacturers and research institutions at their request based on an integrated database of nationwide traffic accident data (approx. 950,000/year), statistics on drivers (76 million persons), census on road traffic (traffic density, road width, etc.), statistics on vehicle ownership (principle statistics such as weight, length and width of 77 million vehicles), etc.

In 1993, our institute opened an office for in-depth investigation studies in Tsukuba, a science town that lies 50 km to the northeast of Tokyo. The office collects in-depth investigation data on about 300 accidents per year.

TRENDS OF TRAFFIC ACCIDENTS IN JAPAN

Accidents in Recent Years

In Japan, the number of fatalities in traffic accidents (within 24 hours) decreased to less than 9,000 in 2001 due to comprehensive countermeasures taken from the beginning of the 1990s. On the other hand, the number of traffic accidents has risen in recent years as shown in Figure 1, recording 1,180,000 casualties in 2001.

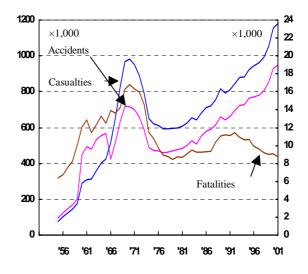


Figure 1. Change in traffic accidents.

Among traffic fatalities classified by road user types, as shown in Figure 2, those of vehicles or motorcycles show a noticeable decrease, while those of pedestrians and pedal cyclists have decreased or leveled off. In Japan, so-called "vulnerable road users" (pedestrians and pedal cyclists) represent about 40% of the total fatalities, accounting for a high percentage of accidents.

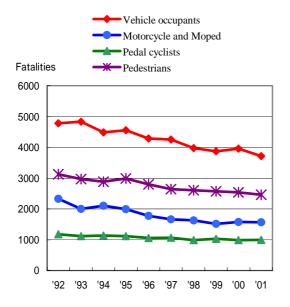


Figure 2. Fatalities by road user type.

Among traffic accidents, vehicle vs. vehicle accidents increased in 2001 to 2.5 times that in 1977 and single-vehicle accidents increased to 1.7 times, while vehicle vs. pedestrian accidents decreased to 0.85 times. Among vehicle vs. vehicle accidents, which have been increasing in the last ten years, rear-end collisions and crossing collisions have increased noticeably (see Figure 3). (Vehicle vs. vehicle accidents include those of four-wheeled vehicle vs. two-wheeled vehicle or bicycle.)

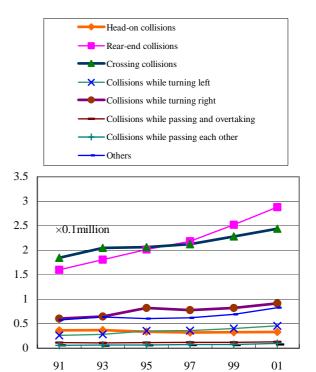


Figure 3. Vehicle vs. vehicle accidents.

Figure 4 shows the percentage of injuries (slight, serious and fatal) in 2001 among rear-end accidents and crossing collisions, two types of accidents that have increased recently. Rear-end collisions account for 37.8% of all vehicle vs. vehicle accidents, but only 14.7% of fatal injuries. On the other hand, crossing collisions represent 28.4% of all vehicle vs. vehicle accidents and 28.5% of the fatal injuries.

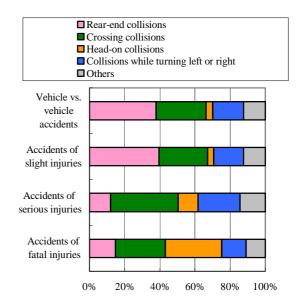
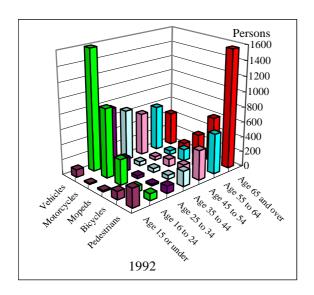


Figure 4. Types of accidents by seriousness of injuries among vehicle vs. vehicle accidents.

Fatalities by Age Group

When comparing 1992 and 2001 by age group, fatalities decreased among the youth (age 16 to 24) in vehicles or on motorcycles, while those of older people (65 and over) in vehicles increased (see Figure 5).

One reason for the reduction of fatalities among the youth is the decrease in speeding accidents above 80 km/h, which is the danger recognition speed (speed at which danger is perceived) (see Figure 6). The increase in the rate of wearing a seat belt in recent years also contributed to the reduced percentage of fatalities while in vehicles (see Figure 7).



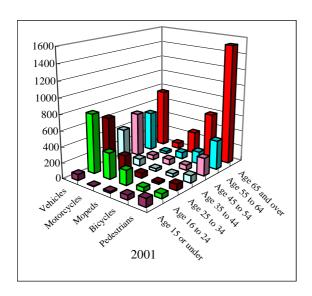


Figure 5. Fatalities by road user type and by age group.



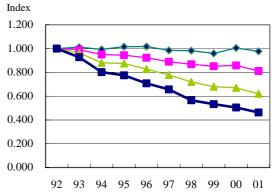


Figure 6. Accidents by danger recognition speed (age 16 to 24).

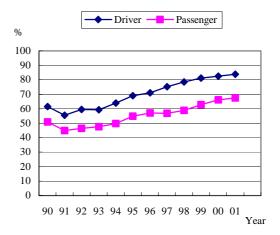


Figure 7. Rate of wearing a seat belt.

Traffic Accidents among Older People

Figures 8 and 9 show types of accidents among two age groups of older people - the early stage of elderliness (age 65 to 74) and the late stage of elderliness (age 75 and over), respectively. Among those in the early elderly stage, fatalities among pedestrians, which are the most common, have tended to level off, but fatalities of those in vehicles have been increasing year by year. In the late elderly stage, fatalities among pedestrians are the most common, representing about 40% of the fatalities of pedestrians of all age groups combined. The fatalities among pedal cyclists and those in vehicles have also increased, although the overall number is not as many.

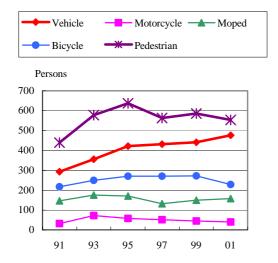


Figure 8. Fatalities among the early elderly stage.

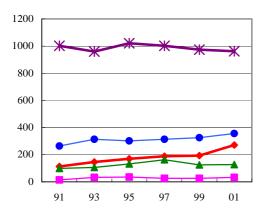


Figure 9. Fatalities among the late elderly stage.

Figure 10 shows driver's license holders in Japan by age group. The group aged 50 to 54 is particularly large compared with other age groups. They are the baby-boom generation born between 1947 and 1950. In ten years, these baby boomers will be in the older group of people.

With the rapidly aging population, Japan sees an increasing percentage of older driver's license holders (Figure 11). With more and more older people driving a vehicle, fatalities among those people have been increasing (Figure 12).

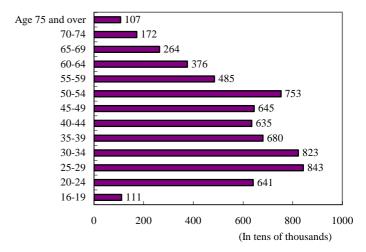


Figure 10. Number of driver's license holders by age group (2001).

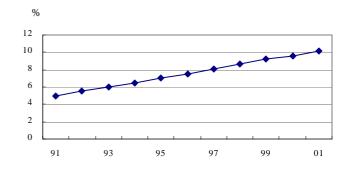


Figure 11. Percentage of older people in driver's license holders.

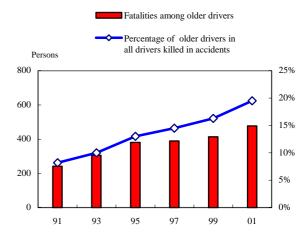


Figure 12. Percentage of older drivers in all drivers killed in accidents.

Among fatalities of occupants in a vehicle, vehicle vs. vehicle accidents represent about 60%, whereas single-vehicle accidents while driving at high speed account for about 40%. Among these vehicle vs. vehicle accidents, the types of accidents by age group are as shown in Figure 13. The number of fatalities among older people age 65 and over due to crossing collisions is particularly greater than in other age groups.

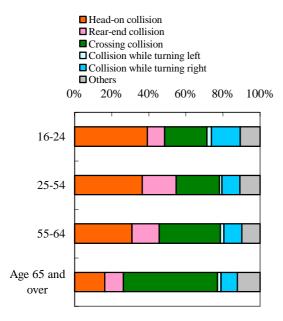


Figure 13. Fatalities by accident type and by age group in vehicle vs. vehicle accidents (2001).

The Rate of Fatalities and Injuries among Older People in Vehicles

The relationship between the damage caused to the vehicle upon collision (classified into major damage, medium damage and minor damage) and fatalities and serious injuries among drivers wearing seat belts was analyzed using the Comprehensive Database on Traffic Accidents (1995-1999). Among fatalities and serious injuries examined by age group, the older the driver is, the more likely to be killed or seriously injured if damage to the vehicle is similar, as shown in Figures 14 and 15.

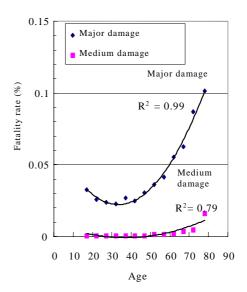


Figure 14. Fatality rate by age group.

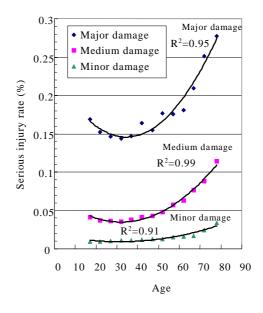


Figure 15. Serious injury rate by age group.

Note 1: Major damage: The vehicle has completely lost its functions and is not repairable.

Medium damage: The vehicle is unable or almost unable to run by itself and would be very difficult to repair.

Minor damage: The vehicle is able to run by itself and is repairable.

Note 2: Fatality rate = fatalities / (fatalities + serious injuries + slight injuries)

Serious injury rate = serious injuries / (fatalities + serious injuries + slight injuries)

Main Injured Body Region of Older Drivers Injured While Driving

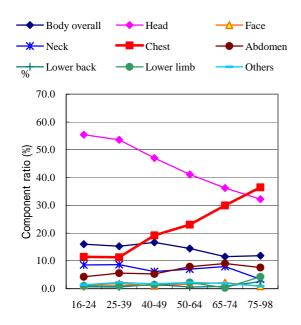
Using the Comprehensive Database on Traffic Accidents, an analysis was made as to whether drivers wearing seat belts were seriously injured or killed in relation to the damage to the vehicle. Figure 16 shows, by age group, the main body region injured among cases of fatalities and serious injuries with major or medium damage to the vehicle. Among fatalities with major damage, the head was the main body region

injured in those up to about age 65, but the chest was the most commonly injured in those beyond age 70.

Among fatalities of people 65 or over with medium damage, the chest is the main body region most commonly injured, although the statistics show variations.

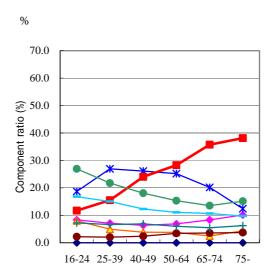
Among serious injuries with major damage and serious injuries with medium damage, the chest is most commonly injured among people beyond age 60.

(1) Fatalities with major damage to vehicle

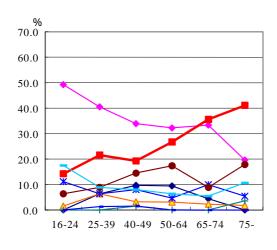


(2) Serious injuries with major damage to vehicle

(%: component ratio)



(3) Fatalities with medium damage to vehicle



(4) Serious injuries with medium damage to vehicle

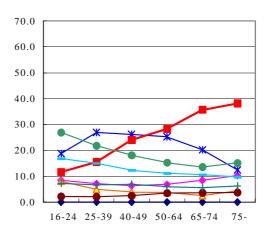


Figure 16. Main body region injured among fatalities and serious injuries, by degree of damage to vehicle (Drivers of a passenger car, wearing seat belts (1995-2001)).

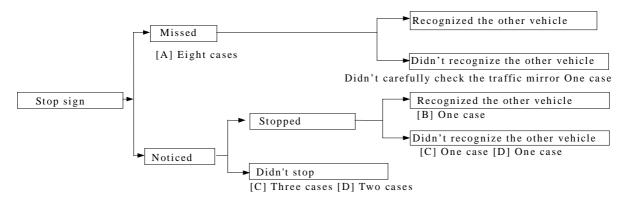
ANALYSIS BASED ON IN-DEPTH **INVESTIGATION DATA**

Analysis of Human Errors Leading to Crossing Collisions of Older Drivers by In-depth **Investigation Data**

Figure 13 shows that older people were more prone to crossing collisions than other age groups. An analysis of human errors leading to such accidents was conducted on thirty-two cases of older drivers age 65 and over involved in an accident, using the data of

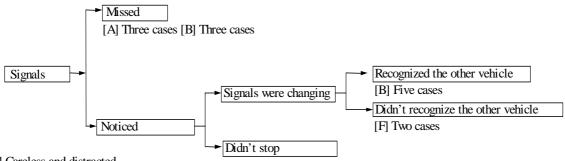
in-depth investigation on scene for the five years preceding 2001 (of which two were excluded as fatalities).

As shown in Figure 17, among the 17 cases of crossing collisions with stop signs, eight were caused when the driver was either careless or distracted and entered the crossing, although at a low speed, without stopping [A]. They represent about half of the human errors leading to crossing collisions.



- [A] Careless and distracted
- [B] Misjudged the distance to and the speed of the other vehicle
- [C] Missed the other vehicle and thought there weren't any vehicles
- [D] Assumed there were no vehicles from past experience

Figure 17. Crossing collisions with stop signs (17 cases).



- [A] Careless and distracted
- [B] Misjudged the distance to and the speed of the other vehicle
- [E] Didn't see the signals at the crossing because the driver had already checked them
- [F] The other vehicle came out of a blind spot (e.g. a large-sized vehicle)

Figure 18. Crossing collisions with traffic signals (13 cases).

As shown in Figure 18, among the 13 cases of crossing collisions with traffic signals, five were caused when the driver " [B] Misjudged the distance to and the speed of the other vehicle", showing a slightly higher frequency than other causes.

Among collisions at a crossing with stop signs, factor

[A] (Figure 17) applies to more than half of the cases. This suggests the validity of a system that "exchanges electronic information between the vehicle and the stop signs before the vehicle enters the crossing and gives prior warning to the driver" or a system that "gives warning, when stop locations have been input to a

navigator, if the vehicle's speed is greater than the calculated one" to ensure that older drivers are well aware of a crossing with stop signs, as effective solutions.

In accidents at a crossing with traffic signals, the factor most commonly identified was " [B] (Figure 18) Misjudgment of the distance to and the speed of the other vehicle". This suggests the deterioration of kinetic vision. As measures to avoid such accidents, it is advisable to reinforce traffic safety education for older drivers and to adopt techniques of Advanced Safety Vehicles (ASV) promoted by the MLIT.

Analysis of Chest Injuries among Older Drivers Based on In-depth Investigation Data

Figures 19 and 20 show the relationship between chest injuries of drivers wearing seat belts and their age among injuries caused by frontal collisions where the relationship between AIS and the barrier equivalent velocity (Vb) was evident, based on the in-depth investigation database between 1994 and 2000.

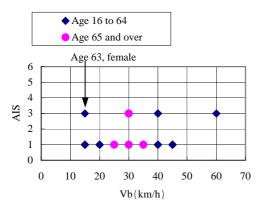


Figure 19. Relationship between AIS and Vb among chest injuries (with the seat belt worn / the air bag deployed).

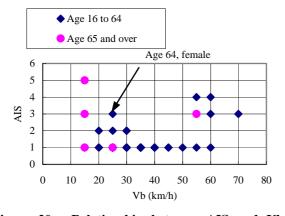


Figure 20. Relationship between AIS and Vb among chest injuries (with the seat belt worn / the air bag not deployed or not equipped).

Among the cases shown in Figure 19 where the occupants were the seat belts and the air bag deployed, older people were injured in 5 cases and other adults (age 16 to 64) were injured in 34 cases. Figure 20 shows 5 cases where the older people were injured while they were wearing seat belts but the airbag was not equipped or it was not deployed, while there were 75 such cases among other adults.

As shown in Figure 20, among the accidents where older people wore their seat belts but were without airbags or the airbags were not deployed, the older people received chest injuries to AIS 5 at a speed of Vb = 15 km/h, each at a speed lower than in other accidents. Furthermore, even among the cases where the airbags were deployed, older people were injured to AIS 3 at a speed of Vb = 15 km/h, assuming a woman of 63 years old is considered as an older person. This shows that the chest impact tolerance of older people is considerably lower than that of other adults who were injured to only AIS 3 at a speed of approximately Vb = 40 km/h.

CONCLUSION

Although traffic fatalities have been decreasing in Japan, the number of fatalities of older people in vehicles has been increasing. Among the fatalities of older people in vehicles examined by type of accident, the percentage of crossing collisions is noticeably greater than in other age groups.

Among collisions at a crossing with stop signs involving older drivers, the most common cases are those in which the driver entered the crossing, although at a low speed, without stopping because they were in a careless and distracted state of mind. Among collisions at a crossing with traffic signals, many were caused by the "misjudgment of distance to and the speed of the other vehicle".

To avoid accidents involving older drivers, further analysis of accidents should be conducted, and to compensate for human errors of older drivers a system using ASV sensor techniques should be introduced.

An analysis of the main part of the body injured in older drivers indicates that they have weaker chest resistance than other age groups. It is hoped that vehicles providing greater safety for not only older people but also other age groups will be developed taking this factor and mitigation of damage into account.

REFERENCES

1." Road Accidents Japan"

Statistics2001

Institute for Traffic Accident Research and Data Analysis

(http://www.itarda.or.jp/)

2. "ITARDA INFORMATION NO.41"

"Injuries of Older Drivers"
Institute for Traffic Accident Research and Data Analysis
(http://www.itarda.or.jp/)

3. "Increasing Fatalities of Older Occupants in Japan"

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